Predictive Thermal Control (PTC) Technology to enable Thermally Stable Telescopes

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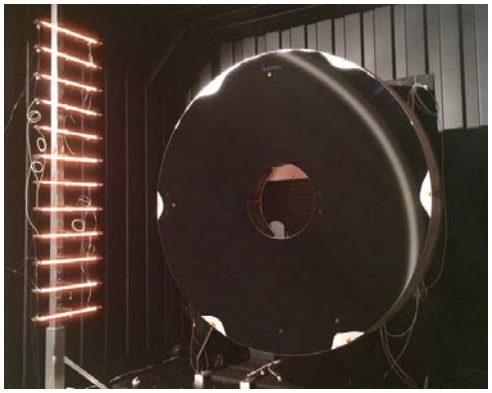
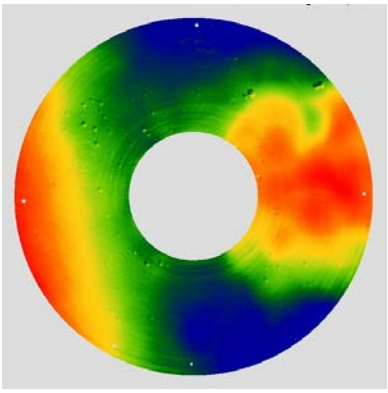
Objectives and Key Challenges:

- Validate models that predict thermal optical performance of real mirrors and structure based on their structural designs and constituent material properties, i.e. CTE distribution, thermal conductivity, thermal mass, etc.
- Derive thermal system stability specifications from science driven wavefront stability requirement
- Demonstrate utility of PTC system for achieving thermal stability

Significance of Work:

- Thermally stable space telescopes enable the desired science of potential HabEx and LUVOIR missions
- Integrated modeling tools enable better definition of system and component engineering specifications





Testing surface shape response of 1.5m ULE mirror to thermal lamp array inside X-Ray & Cryogenic Facility (XRCF)

Approach:

- Science-driven systems engineering
- Mature technologies required to enable highest priority science and result in high-performance, low-cost, low-risk system
- Mature technology in support of 2020 Decadal process

Key Collaborators:

- PTC team at MSFC: Thomas Brooks, Richard Siler & Ron Eng
- Harris Corp: Carl Rosoti, Keith Harvey & Rob Egerman

Current Funded Period of Performance:

Jan 2017 – Sept 2020

Recent Accomplishments:

- ✓ Completed aluminum mirror rough machining & initial diamond turning
- ✓ Completed aluminum mirror stress relief
- ✓ Completed assembly rear heater at MSFC

Next Milestones:

- Complete PTC algorithm development (6/2019)
- Complete aluminum mirror fabrication (6/2019)
- Conduct XRCF testing of aluminum mirror (12/2019)

Applications:

- Flagship optical missions; Explorer-type optical missions
- Department of Defense and commercial observations

$TRL_{In} = 3$ $TRL_{Current} = 3$ $TRL_{Target} = 4 - 5$

(values depend on specific technology)